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MAMMALS OF THE MULESHOE SANDHILLS
BAILEY, HALE, AND LAMB COUNTIES, TEXAS

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A distinct band of isolated sandhills stretches from western Roosevelt County, New Mexico, to western Hale County, Texas. We have named this unique physiographic region the Muleshoe Sandhills because Muleshoe is the largest Texas community in close proximity to it. Our research was concerned with the distribution and natural history of mammals in the Texas part of the Muleshoe Sandhills, which lies in Bailey, Lamb, and Hale counties.

No previous study had dealt specifically with the Muleshoe Sandhills from a mammalogical perspective, although several projects of broader scope have encompassed the region (see, for example, Bailey, 1905; Davis, 1974; Jones *et al.*, 1987, 1988a). Publications detailing the distribution of some of the mammalian taxa that occur on the central Llano Estacado include those of Blair (1954), Desha (1967), Judd (1970), Schmidly (1971, 1984), Baumgardner and Schmidly (1981), Hollander *et al.* (1987), Manning *et al.* (1988), and Choate *et al.* (1990), among others.

METHODS AND MATERIALS

This study was initiated in the late autumn of 1987 and continued through the summer of 1989. We trapped and observed mammals in all three counties of the study area in every season. Mammals were collected by a variety of methods including use of

Sherman live traps, Victor rat traps, Museum Special snap traps (total of approximately 2600 trap nights), McAbee gopher traps, and steel leg-hold traps. Additional specimens were caught by hand or salvaged from animals killed along roadways; a few were shot, and some were obtained by examination of owl pellets. Eight pitfall traps set in Hale County for eight months were checked periodically, but no mammals were captured in them.

Specimens housed in The Museum of Texas Tech University that were collected by others prior to our study were incorporated into our data base, resulting in a total of more than 800 specimens examined. Additionally, Aday and Gennaro (1973) provided records of mammals occurring in the New Mexican part of the Muleshoe Sandhills (Roosevelt County), which were especially helpful in documenting occurrence of those species for which we had few or no records. All specimens collected during our survey (approximately 600) are deposited in The Museum of Texas Tech University. Most were prepared as standard museum skins accompanied by skulls; a few were preserved in fluid, whereas others were retained as skeletal material only.

Data recorded in the field or laboratory included morphometric measurements, variation in pelage with respect to age and season, molt patterns, and reproductive information such as testicular size in males and reproductive condition of females (number and size of fetuses, lactation, and the like). When appropriate, standard cranial measurements were recorded. Most were taken using Fowler Ultra-Cal II digital calipers (to the nearest 0.01 millimeter). Some measurements, however (breadth of interparietal bone and length of upper and lower alveolar toothrows in *Perognathus*, for example), were taken using a compound dissecting microscope fitted with an ocular micrometer (calibrated to 0.1 millimeter).

Dominant plant species were noted at collecting sites, and vegetative communities were categorized. Occurrence of plants was correlated with the distribution and relative abundance of selected mammalian species.

DESCRIPTION OF THE STUDY AREA

Geography

The Muleshoe Sandhills are located in the western part of the Llano Estacado or Staked Plains (Fig. 1). The region is characterized by gently rolling hills and dunes, most of which are covered with native vegetation—grasses, shrubs, and yucca.

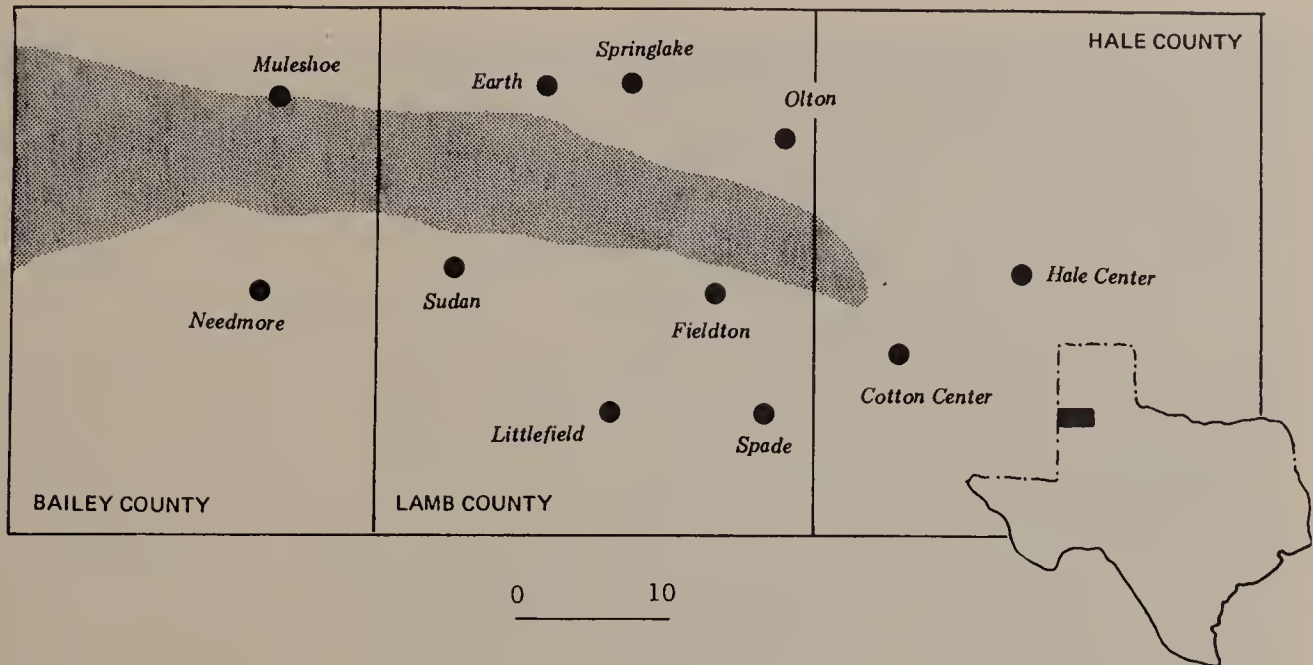


FIG. 1.—Map showing extent of Muleshoe Sandhills in Texas. Localities mentioned in text are plotted. The scale is in miles.

The sandhills are noticeably set apart from other areas of Bailey, Lamb, and Hale counties, the topography of which is nearly flat and under intensive cultivation. Elevation ranges from about 3900 feet above sea level near the New Mexico border to 3500 feet in Hale County.

The sandhills constitute one of the largest contiguous concentrations of sandy soil found on the Llano. From western Roosevelt County, New Mexico, to Hale County, Texas, they extend approximately 105 miles from west to east. In Texas, they measure some 58 miles eastward from the New Mexico line; from north to south, they vary from 10 miles wide on the state border to less than two miles wide in Hale County (Fig. 1).

The Muleshoe Sandhills are primarily wind-deposited sands of late Pleistocene and Holocene origin, and their location is closely tied to ancient drainage channels. This drainage system contributed to the building of the sandhills (Ross and Bailey, 1967), and remnants of it can be seen in the several draws presently found in the study area.

Soil

Most soils found in the Muleshoe Sandhills consist of fine sand of the Tivoli-Brownfield association. Loamy fine sands and fine sandy loams prevail at the periphery of the sandhills (Amarillo association), as do soils of high lime content near Coyote Lake in Bailey County (Arch-Drake association). Dunes (Fig. 2) found in the sandhills are unstabilized areas of varying size supporting



FIG. 2.—Sand dunes on Texas–New Mexico border, Bailey County.

little or no vegetation. As dunes age, they become stabilized with vegetation and a fine-grained topsoil develops (Fig. 3).

Soils surrounding the sandhills are predominantly clay or loam types. These soils are not subject to much eolian disturbance, except as a result of farming operations. The finer sands within the sandhills may shift and blow, however. Although fixation and soil stratification does occur, major changes probably take place over considerable time.

Climate

The Muleshoe Sandhills share the same semiarid, interior climate characteristic of the Llano Estacado. Summer temperatures are moderate to warm. There is a marked difference between maximum daytime temperatures and minimum nighttime temperatures throughout the year due to the high elevation, low humidity, and clear skies, which allow maximum penetration of solar radiation. Winter temperatures often fluctuate rapidly as Canadian fronts move south across the Great Plains. However, cold weather usually does not last more than a few days. Spring is the most variable season with regard to temperature. At Muleshoe, weather data for the period 1951–1980 indicate that January is the coldest month in the year and July is the warmest (average daily maxima 52.2° and 91.4° F,



FIG. 3.—Sand dune in process of stabilization, western Bailey County.

and average daily minima 20.0° and 63.7° , respectively). The average annual daily minimum and maximum temperatures were 41.3° and 72.5° .

Winds are predominantly from the south and southwest and frequently are strong, especially in early spring, often causing dust storms. Strong winds of short duration accompany frequent thunderstorms of late spring and early summer. Monthly and annual amounts of rainfall are quite variable; annual precipitation averaged 16.08 inches in the three decades 1951–1980. Winters are fairly dry because cold fronts from the north and west often prevent moisture from the Gulf of Mexico from reaching the Llano. Humidity is usually low, with slight seasonal variation.

Vegetation

Common plant species found at our trapping sites in the Muleshoe Sandhills are listed in Table 1 (nomenclature generally follows Barkley, 1986). This list includes plants only from selected localities and, therefore, is not an inventory of plant species from the sandhills. An analysis of the flora of Bailey County was reported by Rosson (1971). Other useful references concerning plants of the Llano, especially in sandy soil habitats

therein, are Tharp (1939), Blair (1950), Allred and Mitchell (1955), Gould (1978), and McMahan *et al.* (1984).

Plant species were inventoried at 45 trap sites and grouped into six major communities based on species composition. Some sites represent disclimax associations. The six plant communities are defined below.

Hackberry-shrub.—Characterized by hackberry and shrubs such as skunkbush and sand sage, this habitat was most apparent in the vicinity of Blackwater Draw. Other plant species commonly found in this community are soapberry, wild grape, sunflower, and native grasses. (Fig. 4).

Havard shin oak-mixed grass.—This is the least common plant community in the study area, found primarily in western Bailey County. Aside from shin oak, mesquite, yucca, and plum were common species; sand sage was uncommon. (Fig. 5).

Mixed grasses-yucca.—This community is characterized by a variety of mid- and short-grasses such as silver bluestem, buffalo-grass, lovegrass, sand dropseed, sandbur, and various grammas, interspersed with yucca, ragweed, and broomweed (Fig. 6).

Sand sage-midgrass.—Found throughout Lamb and Hale counties, the midgrasses of this community are mostly replaced by a disclimax of weedy plants and yucca at some localities. Common grass species include windmill grass, sideoats grama, sand bluestem, and little bluestem. Skunkbush, yucca, plum, and sunflower may be present (Fig. 7).

Sand sage-ragweed-yucca disclimax.—This is the most common habitat type in the tricounty study area. Codominants are sand sage and ragweed, but yucca always is present. Other species found in this community include sunflower, panicum, sandbur, Russian thistle, and buffalo-gourd (Fig. 8).

Tallgrass-ragweed-Russian thistle disclimax.—This habitat type was found primarily in Bailey County, sparingly in Lamb and Hale counties. Ragweed and Russian thistle obviously are recent invaders to this tallgrass community. Native grasses including big bluestem, Johnson grass, giant dropseed, and lovegrass frequently are present, as are sunflower and sand sage.

Some localities in the Muleshoe Sandhills could not be classified into one of the previously listed plant communities. These either represent successional areas or are places of intergradation of two or more communities (see Fig. 9, which depicts a community of sand sage, shin oak, and mixed grasses, along with mesquite and yucca).

TABLE 1.—Some common plant species found in the Muleshoe Sandhills. Nomenclature and sequence of taxa follow Barkley (1986).

Juniper	<i>Juniperus</i> sp.
Prickly poppy	<i>Argemone</i> sp.
Hackberry	<i>Celtis</i> sp.
Havard shin oak	<i>Quercus havardii</i>
Prickly pear	<i>Opuntia</i> sp.
Russian thistle (tumbleweed)	<i>Salsola iberica</i>
Smartweed	<i>Polygonum</i> sp.
Buffalo-gourd	<i>Cucurbita foetidissima</i>
Cottonwood	<i>Populus</i> sp.
Willow	<i>Salix</i> sp.
Peppergrass	<i>Lepidium</i> sp.
Plum	<i>Prunus</i> sp.
Mesquite	<i>Prosopis glandulosa</i>
Grape	<i>Vitis</i> sp.
Soapberry (Chinaberry)	<i>Sapindus saponaria</i> (v. <i>drummondii</i>)
Skunkbush	<i>Rhus aromatica</i> (v. <i>trilobata</i>)
Western ragweed	<i>Ambrosia psilostachya</i>
Sand sage	<i>Artemisia filifolia</i>
Broomweed (snakeweed)	<i>Gutierrezia</i> sp.
Sunflower	<i>Helianthus</i> sp.
Western wheatgrass	<i>Agropyron smithii</i>
Big bluestem	<i>Andropogon gerardii</i>
Sand Bluestem	<i>Andropogon hallii</i>
Silver bluestem	<i>Andropogon saccharoides</i>
Little Bluestem	<i>Andropogon scoparius</i>
Sideoats grama	<i>Bouteloua curtipendula</i>
Blue grama	<i>Bouteloua gracilis</i>
Buffalograss	<i>Buchloe dactyloides</i>
Sandreed	<i>Calamovilfa</i> sp.
Sandbur	<i>Cenchrus incertus</i>
Windmill grass	<i>Chloris</i> sp.
Weeping lovegrass	<i>Eragrostis curvula</i>
Sand lovegrass	<i>Eragrostis trichodes</i>
Panicum (switchgrass)	<i>Panicum</i> sp.
Indian grass	<i>Sorghastrum nutans</i>
Johnson grass	<i>Sorghum halepense</i>
Sand dropseed	<i>Sporobolus cryptandrus</i>
Giant dropseed	<i>Sporobolus giganteus</i>
Yucca	<i>Yucca</i> sp.



FIG. 4.—Hackberry-shrub community, south of Olton, Lamb County.



FIG. 5.—Havard shin oak-mixed grass community, western Bailey County.



FIG. 6.—Mixed grass-yucca community, north of Fieldton, Lamb County.



FIG. 7.—Sand sage-midgrass community, southwest of Muleshoe, Bailey County.



FIG. 8.—Sand sage-ragweed-yucca disclimax, north of Sudan, Lamb County.



FIG. 9.—Intergrading communities of sand sage, Havard shin oak, and grasses west of Muleshoe, Bailey County.

ACCOUNTS OF SPECIES

The following accounts are based on mammals obtained or observed in the Muleshoe Sandhills. Taxa are arranged in currently accepted phylogenetic sequence except for species in the same genus, which are in alphabetical order. Appended to the accounts is a list of several species of possible occurrence. Vernacular names follow those used by Jones *et al.* (1986). All measurements of specimens are in millimeters and weights are in grams.

Didelphis virginiana virginiana Kerr, 1792

Virginia Opossum

A narrow, discontinuous, and depauperate riparian community occurs in the sandhills along Blackwater Draw, and this species probably reached the area, where it now occurs sparingly, by that means. Possibly abandoned farmsteads provide marginal cover in some places. In addition to the specimen listed below, we noted dead opossums along a roadway approximately 9 mi. S Earth, Lamb County, in both 1988 and 1989, and collected or observed individuals at several locations adjacent to the study area. A landowner in eastern Lamb County reported to us that he had seen opossums in the sandhills on his property.

Specimens examined (1).—BAILEY CO.: 1 mi. N, 6 mi. W Muleshoe, 1.

Cryptotis parva parva (Say, 1823)

Least Shrew

This species recently was reported from the Muleshoe Sandhills in adjacent Roosevelt County, New Mexico, and also from Muleshoe National Wildlife Refuge to the south of the sandhills in Bailey County (Owen and Hamilton, 1986). We recovered remains of two individuals from cast pellets of barn owls found in the woodlot of an old homestead located 1 mi. N and 5 mi. E Fieldton, Lamb County (Pesaturo *et al.*, 1989). These two shrews probably were captured by owls between early October 1988 and early January 1989. Evidently, *C. parva* has extended its distribution westward in recent years, possibly in response, in part at least, to widespread irrigation on the Llano Estacado.

Sylvilagus audubonii neomexicanus Nelson, 1907

Desert Cottontail

Cottontails are widespread and common in and around the sandhill region. However, despite the fact that *S. audubonii* is an upland inhabitant, we collected specimens only from Bailey County. Nevertheless, material examined from localities in Hale and Lamb counties near the sandhills indicates that this cottontail occurs throughout the study area.

A female taken on 30 April carried four fetuses that measured 19 in crown-rump length. An immature male obtained on 26 July had testes measuring 27 in length; those of an adult from 28 September measured 34.

Specimens examined (5).—BAILEY CO.: Muleshoe, 2; 2 mi. S, 10 mi. W Muleshoe, 1; 7 mi. S, 2 mi. W Muleshoe, 1; 8 mi. S, 10 mi. W Muleshoe, 1.

Sylvilagus floridanus llanensis Blair, 1938

Eastern Cottontail

Rather surprisingly, this species, typical of more mesic habitats, seems to be distributed throughout the study area. However, indications are that it is more likely to be found near irrigated farming operations along the periphery of the sandhills as well as around the few irrigated fields in sandy soil. A female taken on 30 April contained five fetuses measuring 27 in crown-rump length. An adult male captured on 3 May had testes 55 in length.

S. floridanus and *S. audubonii* are similar in appearance and sometimes difficult to distinguish externally at first glance. *S. floridanus* has somewhat darker and shorter ears (usually less than 60) than does *audubonii*, is slightly darker dorsally overall, and usually has a greater suffusion of buffy-orangish coloration, particularly on the nape. Cranially, *floridanus* has much smaller bullae, a noticeably broader mesopterygoid fossa, a smaller external auditory meatus, and a longer maxillary toothrow.

Specimens examined (4).—BAILEY CO.: 0.5 mi. S, 10.5 mi. W Muleshoe, 1. LAMB CO.: 4 mi. S Springlake, 1; 5.5 mi. N Fieldton, 1. HALE CO.: 10.5 mi. W Hale Center, 1.

Lepus californicus melanotis Mearns, 1890

Black-tailed Jackrabbit

Jackrabbits were observed in sandhill habitats in all three counties, some killed along roadways, although we did not find this species to be as common as at other places in the central part

of the Llano Estacado. Our specimens seem best assigned to the subspecies *L. c. melanotis*, although variation in this species on the Llano and details of distribution of *melanotis* with respect to that of *L. c. texianus*, which has been reported from the southern part of the region, remain to be studied.

Subadult males taken on 5 August and 4 November had testes that measured 28 and 19 in length, respectively. An adult female shot on 30 April was lactating and carried two fetuses (crown-rump length, 110); another captured on 28 June had a flaccid uterus but was not visibly pregnant.

Specimens examined (4).—BAILEY CO.: 1 mi. N, 11 mi. W Muleshoe, 1; 1.5 mi. WNW Muleshoe, 1. LAMB CO.: 8 mi. S Earth, 1; 7 mi. S, 1.5 mi. E Olton, 1.

Spermophilus spilosoma marginatus Bailey, 1890

Spotted Ground Squirrel

Although found throughout the Muleshoe Sandhills, the spotted ground squirrel does not appear to be particularly abundant. Four of our specimens from Bailey County came from coarse-textured, reddish-brown sands of the Amarillo series on the southern edge of the sandhills, where they were shot along roadways. Of the two ground squirrels occurring in the region, this species appears to be more common westwardly than is *S. tridecemlineatus*; we never observed the two species at the same place.

Adult males collected on 30 April (two) and 1 July had testes 22, 24, 13, respectively, in length. Nonpregnant females were taken on 1 April and 30 April, whereas a lactating individual was recorded on 3 June and one captured on 4 August had completed lactation.

Specimens examined (7).—BAILEY CO.: 3.2 mi. S, 5.5 mi. W Muleshoe, 1; 6 mi. S, 1 mi. W Muleshoe, 1; 6.5 mi. S, 6 mi. W Muleshoe, 1; 6.5 mi. S, 2.5 mi. W Muleshoe, 2. LAMB CO.: 7 mi. S Olton, 1; 4.1 mi. NE Hart Camp, 1.

Spermophilus tridecemlineatus arenicola (A. H. Howell, 1928)

Thirteen-lined Ground Squirrel

This sciurid was collected along roadside rights-of-way in Bailey and Lamb counties. Although nowhere especially common, *S. tridecemlineatus* seemed to be more widely distributed in the eastern part of the region than in the west, and often was observed in peripheral areas of sandy habitat.

Adult males collected on 1 April (two) and 22 April had testes measuring 20, 19, and 20 in length. Females taken on 1 and 22

April were not visibly pregnant. Young animals were captured on 13 June and 4 July.

Specimens examined (7).—BAILEY CO.: 3.5 mi. S, 10 mi. W Muleshoe, 1. LAMB CO.: 12 mi. N Sudan, 1; 10 mi. N, 0.2 mi. W Sudan, 1; 9.5 mi. N Sudan, 3; 2.6 mi. N Fieldton, 1.

Cynomys ludovicianus ludovicianus (Ord, 1815)

Black-tailed Prairie Dog

Colonies of black-tailed prairie dogs were found at scattered locations on shallow sandy soils in Bailey and Lamb counties, in flat, short-grass habitats with occasional small mesquite trees. Most "towns" were small, no more than a hundred yards or so in diameter, but at least one in Bailey County was a quarter of a mile or more in extent along both sides of a roadway and at least as wide on both sides. Colonies were observed as follows: 2 mi. S, 10 mi. W Muleshoe, 2 mi. S Muleshoe, and 6 mi. S, 10 mi. W Muleshoe, Bailey County; 9 mi. N Sudan, 7 mi. S, 2.5 mi. E Earth, and 7.5 mi. S Springlake, Lamb County. A male with abdominal testes (12 × 5) and a nonpregnant female, obtained on 1 April and 30 April, respectively, were in process of spring molt.

Specimens examined (4).—BAILEY CO.: Muleshoe, 1; 2 mi. S, 10 mi. W Muleshoe, 1; 2 mi. S Muleshoe, 1; 6 mi. S, 10 mi. W Muleshoe, 1.

Geomys bursarius major Davis, 1940

Plains Pocket Gopher

This pocket gopher is common, in some places abundant, in the Muleshoe Sandhills. Most of our specimens came from rights-of-way along highways and roadways, and from sandy bar ditches, although the species is distributed generally throughout the region. Presently, it is known to come into contact with another gopher, *Cratogeomys castanops*, only at one place as described in the account of that species, but the two also may occur parapatrically elsewhere, particularly along the periphery of the sandhills. As has been found in other studies, there are more females among our specimens than males, 21 as opposed to 12.

A female trapped on 8 April carried two fetuses (39 in crown-rump length); another obtained on 25 March had three placental scars but was not lactating. Nonpregnant females in adult pelage were taken in January, February, June, July, and October. Animals in juvenile pelage or molting from that pelage were collected in March, May, June, July, and September. Adult males had testicular lengths of 25 in January, 24 and 23 in

February, 23 and 18 in April, 12 in July, and 13 and 9 in October. From these rather meager data, it appears that *G. bursarius* breeds from mid-winter to late spring or perhaps early summer in the Muleshoe Sandhills.

Specimens examined (33).—BAILEY CO.: 2-3.6 mi. SE Muleshoe, 5; 3 mi. S, 18 mi. W Muleshoe, 1; 6-6.2 mi. S Muleshoe, 3; 6.5 mi. S, 2.5 mi. W Muleshoe, 1; 6-7 mi. S, 1 mi. E Muleshoe, 2. LAMB CO.: 4 mi. S, 2.5 mi. E Earth, 4; 4.5-5 mi. S Earth, 3; 6 mi. N Sudan, 1; 6.5 mi. S Olton, 2; 2-3.5 N Fieldton, 5; 1-1.5 mi. N, 5 mi. E Fieldton, 4. HALE CO.: 4 mi. N, 5.5 mi. W Cotton Center, 2.

Cratogeomys castanops perplanus Nelson and Goldman, 1934
Yellow-faced Pocket Gopher

This species enjoys a widespread distribution on the Llano Estacado, including areas immediately surrounding the Muleshoe Sandhills. It is not ordinarily found in sandy soils on the Llano, however, these being occupied by *Geomys bursarius*. Distribution of the two gophers is parapatric where their ranges abut.

In August and October of 1975, R. C. Dowler trapped pocket gophers at a Southwest Public Service Company station south of Earth. Here, sand had been cleared away down to caliche from a considerable area in order to construct buildings on the site. *Cratogeomys* burrows were in this altered habitat. Both Dowler and our parties took *Geomys* in sandy banks along a roadside just opposite the power plant. The only other *C. castanops* in our material came from the edge of the sandhills where we would expect to find interspersed populations of the two gophers.

Two females taken on 5 October were lactating. A nonpregnant animal was trapped on 20 August. Molting adults were obtained in both August and October.

Specimens examined (6).—LAMB CO.: 4.8 mi. S, 0.3 mi. W Earth, 5; 5.5 mi. S Olton, 1.

Perognathus flavescens copei Rhoads, 1894
Plains Pocket Mouse

The plains pocket mouse is common in the sandhills, most frequently in relatively open areas where *Dipodomys ordii*, *Peromyscus maniculatus*, and *Onychomys leucogaster* are common associates. For example, on 2 July 1989, from 140 Sherman traps set in Hale County in an area dominated by sand sage, skunkbush, yucca, and sunflower, and with some grasses and weeds, we took seven *P. flavescens*, seven *D. ordii*, two *O. leucogaster*, one *P. maniculatus*, and one *Chaetodipus hispidus*. In Lamb County on 5 September 1988, at a place where sand sage, yucca, skunkbush, and midgrasses

prevailed, we trapped five *P. flavescens*, 10 *D. ordii*, three *O. leucogaster*, and one *P. maniculatus* in 108 Shermans.

Many of our mice were trapped along fencerows. Except for August, we have specimens from the months of May through December. Small pocket mice, presumably *P. flavescens*, were one of the most common small mammals taken by barn owls at the edge of the sandhills in Lamb County (Pesaturo *et al.*, 1989).

Pregnant females taken on 5 June and 2 July (two), carried four, five, and five fetuses, respectively, with crown-rump lengths of 7, 4, and 12. Nonpregnant adults were collected in May, July, September, and November. Testicular lengths of adult males measured 3-6 in May, 4-6 in June, 5-7 in July, 3-6 in September, and 3 (abdominal) for two in October. Animals in juvenile pelage or molting from that pelage were trapped in May, June, July, and October.

Reed and Choate (1986) recently reviewed the systematics of this species on the Great Plains, referring all Texas specimens they examined to the subspecies *P. f. copei*. In northwestern Texas, this race seemingly occurs in isolated or semi-isolated populations wherever sandy or sometimes sandy-loam soils prevail. Average (and extreme) external measurements of 20 adults (14 males and six females) from the Muleshoe Sandhills are as follows: total length, 122.6 (117-134); length of tail, 56.3 (51-61); length of hind foot, 16.1 (15-17); length of ear, 6.8 (6-8). Weights of 14 males from this series averaged 9.4 (8.1-10.7). Three nonpregnant females weighed 8.2, 9.0, and 9.9. For cranial measurements, see Table 2.

Specimens examined (43).—BAILEY CO.: 0.5 mi. S, 18.2 mi. W Muleshoe, 2; 2 mi. S, 7.5 mi. W Muleshoe, 1. LAMB CO.: 4.6 mi. S, 2.6 mi. E Earth, 2; 5 mi. S, 2.5 mi. E Earth, 3; 6.5 mi. S Springlake, 7; 8 mi. S Springlake, 1; 5.5-7 mi. S Olton, 2; 3-4 mi. N Fieldton, 16; 3 mi. N, 1 mi. W Fieldton, 1. HALE CO.: 4-4.5 mi. N, 5.5 mi. W Cotton Center, 8.

Perognathus flavus gilvus Osgood, 1900

Silky Pocket Mouse

This species typically does not occur on fine, sandy soils. Thus, although it is found all around the Muleshoe Sandhills, we did not expect to find that it occurred within the area, where *P. flavescens* is the common small pocket mouse. However, an adult female *P. flavus* was trapped 3.2 mi. N Fieldton, Lamb County (about a mile within the sand), in association with *flavescens*, on 2 December 1967. It clearly differs from specimens of the latter in being smaller and darker, less buffy dorsally and especially on

TABLE 2.—Cranial measurements of adults of the two species of *Perognathus* from the Muleshoe Sandhills. Sample sizes in parentheses; superscript numbers indicate fewer specimens than sample size.

Statistics	Greatest length of skull	Length of rostrum	Postorbital constriction	Greatest breadth of skull	Breadth of interparietal	Length of max. toothrow	Length of mand. toothrow
<i>Perognathus flavus gilvus</i> , Lamb County, Texas							
TTU 6032, ♀	20.49	6.98	4.42	12.30	3.4	3.3	3.0.
<i>Perognathus flavescens copei</i> , Bailey, Lamb, and Hale counties, Texas (35)							
Ave. (23♂, 12♀)	21.48 ³¹	7.53 ³¹	5.13	12.31	4.6	3.3	3.2
Min.	20.44	6.80	4.64	11.60	3.9	2.9	2.9
Max.	22.53	8.23	5.51	13.17	5.5	3.5	3.4

flanks, having larger postauricular patches, larger tympanic bullae, and a narrower interparietal bone. External measurements: total length, 105; length of tail, 51; length of hind foot, 14; length of ear, 6; weight (nonpregnant), 7.3 See Table 2 for cranial measurements. It is noteworthy that Aday and Gennaro (1973) also recorded *P. flavus* from several localities in the sandhills near the Texas border in eastern New Mexico.

Populations now assigned (Hall, 1981) to *P. flavus* from western Texas are in need of taxonomic review. We tentatively refer our specimen to *flavus* and to the subspecies *gilvus* following Wilson (1973), who presented evidence that *flavus* and *merriami* (with which *gilvus* previously was associated) represent a single species.

Chaetodipus hispidus paradoxus (Merriam, 1889)

Hispid Pocket Mouse

Chaetodipus hispidus is distributed generally throughout the sandhills region and in adjacent areas, but we found it only locally common. The largest number taken at a single locality was 15 (in 118 Sherman traps) on 8 October 1988 northwest of Cotton Center, Hale County. Our impression is that this species occupies relatively thick, brushy-weedy habitats, in company with *Reithrodontomys megalotis*, to a much greater degree than do other

heteromyids. Hispid pocket mice commonly were taken by barn owls at a place near the edge of the sandhills in Lamb County (Pesaturo *et al.*, 1989).

A pregnant female carrying seven fetuses (crown-rump length 10) was taken on 8 June. Animals in juvenile pelage (or molting from that pelage) were collected in March, May, July, October, and November. Testes of adult males measured 9 (March), 10-16 (May), 10-13 (June), 9 (July), and 3-9 (October).

Twenty adults (12 males and eight females) had the following average (and extreme) external measurements: total length, 219.0 (204-240); length of tail, 103.7 (93-117); length of hind foot, 25.4 (23-27); length of ear, 12.7 (11-15). Weights of 12 males from this series averaged 51.0 (36-69); seven nonpregnant females had an average weight of 41.9 (36-51).

Specimens examined (44).—BAILEY CO.: 2 mi. S, 7.5 mi. W Muleshoe, 1; 3.2 mi. S, 7.5 mi. W Muleshoe, 5; 4 mi. S, 1 mi. W Muleshoe, 1; 6 mi. S, 1-2 mi. E Muleshoe, 2; 7 mi. S, 3.5 mi. E Muleshoe, 1; 8.5 mi. S, 16.5 mi. W Muleshoe, 1. LAMB CO.: 7.2 mi. S Earth, 1; 6.5-8.5 mi. S Springlake, 3; 5.5-7 mi. S Olton, 7; 14.8 mi. N Littlefield, 1. HALE CO. 4-4.5 mi. N, 5.5 mi. W Cotton Center, 21.

Dipodomys ordii medius Setzer, 1949

Ord's Kangaroo Rat

This heteromyid is probably the most abundant, certainly the most conspicuous, small mammal of the Muleshoe Sandhills. We trapped or observed signs of kangaroo rats in all habitats sampled, but *Dipodomys* was most frequently taken along sandy roadways, in blowout and dune areas, and other places where bare patches of sandy soil prevailed. Tracks of these rodents frequently were visible by day as were their burrows in sandy banks and hillsides, at the base of dunes, and beneath shrubs. Kangaroo rats also were common prey of owls in the region as judged by remains found in pellets from Lamb (Pesaturo *et al.*, 1989) and Bailey counties. A farmer from Hale County complained to us that these rats dug up watermelon seeds near the margins of fields in which they had been planted.

We examined more specimens of *D. ordii* in this study than of any other species. Our material is tentatively referred to the subspecies *D. o. medius*, with type locality at Santa Rosa, Guadalupe Co., New Mexico, to the northwest, following Setzer (1949). Its relationship to the older-named *D. o. richardsoni*, which occurs to the north, has not been resolved in detail. Although Schmidly (1971) studied variation in *ordii* in western Texas (see

also Desha, 1967), and concluded that rats from Hemphill County (north of the Canadian River in the Panhandle) differed from those in populations to the south (including one from Needmore, Bailey County) to a greater degree than the latter differed from each other, he drew no taxonomic conclusions regarding the variation. Jones *et al.* (1988b:26) opined that “the Canadian River and its breaks could provide an area where gene flow is, in part at least, discontinuous between populations distributed to the north [*richardsoni*] and south [*medius*].” Also, populations on the Llano Estacado may differ from those to the east (because both Setzer, 1949:520, and Baumgardner and Schmidly 1981:25, listed as *richardsoni* a few specimens from the Rolling Plains to the east of the Llano). In any event, variation in *D. ordii* on the Llano Estacado and in adjacent areas of western Texas and eastern New Mexico, and the taxonomic inferences that can be drawn therefrom, will be a fruitful area for future study.

Gravid females were captured in the months of January, February, March, April, May, July, September, October, and November. Two lactating animals were taken in March. Number of fetuses in 21 pregnant animals plus one instance of newborn young in a trap ranged from two to four, with a mode of two and an average of 2.6. Two neonates born in a Sherman live trap, a male and female, had the following respective external measurements: total length, 65, 64; length of tail, 22, 22; length of hind foot, 12, 12; length of ear, 2, 2; weight, 7.0, 6.4. Testicular lengths of 63 adult males from our series measured 12–15 in January, 10–14 in February, 4–13 in March, 8–13 in April, 12–15 in May, 9–14 in June, 7–13 in July, 9–12 in September, 11–13 in October, and 12–14 in November.

Specimens examined (198).—BAILEY CO.: 0.5–2.5 mi. S, 18.2 mi. W Muleshoe, 4; 2 mi. S, 10 mi. W Muleshoe, 2; 3.2 mi. S, 2.7–3.1 mi. W Muleshoe, 5; 4 mi. SW Muleshoe, 1; 4 mi. S Muleshoe, 1; 4 mi. S, 1–2 mi. W Muleshoe, 15; 4 mi. S, 1 mi. E Muleshoe, 1; 5 mi. S, 18 mi. W Muleshoe, 4; 5.5 mi. S, 10 mi. W Muleshoe, 4; 6 mi. S, 1–3 mi. E Muleshoe, 26; 8.5 mi. S, 16.5 mi. W Muleshoe, 2; 9.5 mi. S, 13 mi. W Muleshoe, 15; 9.5 mi. S, 8.5–9 mi. W Muleshoe, 2. LAMB CO.: 7.2–7.5 mi. S Earth, 5; 4 mi. S, 2.5 mi. E Earth, 5; 5–5.5 mi. S, 2.5 mi. E Earth, 25; 6–6.5 mi. S Springlake, 9; 6–7.5 mi. N Sudan, 7; 14.1–14.7 mi. N Littlefield, 5; 6.5 mi. N, 0.5 mi. E Fieldton, 1; 3–4 mi. N Fieldton, 35; 7 mi. S Olton, 6; 8.5 mi. S, 1 mi. E Olton, 3; 10.6 mi. N Spade, 2. HALE CO.: 0.5 mi. N, 12.5 mi. W Hale Center, 1; 4–4.5 mi. N, 5.5 mi. W Cotton Center, 12.

Additional records (Setzer, 1949:520).—BAILEY CO.: 6 mi. SW Muleshoe; 9 mi. SW Muleshoe.

Reithrodontomys megalotis aztecus J. A. Allen, 1893

Western Harvest Mouse

We found this harvest mouse to be common in the Muleshoe Sandhills, restricted primarily to weedy, brushy, or grassy fence-rows. Frequently it was taken in association with *Chaetodipus hispidus*, but was trapped along with *Dipodomys*, *Onychomys*, and *Peromyscus* as well. On one occasion, we took a western harvest mouse and a kangaroo rat in the same live trap.

Our largest series, 23 specimens, was collected in January, May, and October, northwest of Cotton Center, in the small extension of the sandhills into Hale County. Here, the mice were taken in dense weedy cover atop a burm and along fencerows overgrown with weeds, grasses, and some yucca and mesquite.

R. megalotis apparently breeds throughout the warm months in northwestern Texas. We took pregnant females in March, April, May, October, and November. In seven pregnancies, number of fetuses ranged from three to six (average, 4.1). Three neonates (born in a live trap) had the following ranges of external measurements: total length, 38-40; length of tail, 9-10; length of hind foot, 5-6; weight, 1.0-1.1. Nonpregnant adult females were captured in the months of January, February, March, April, May (including one postlactating), and June. A lactating individual was trapped in March.

Testes of adult males measured 4-7 in January, 4-6 in February, 8-9 in March, 4-8 in April, 6-9 in May, 7-9 in June, 9 in July, and 8 (two) in October. Juvenile animals were trapped in May, June, and October.

We follow Jones and Mursaloğlu (1961) in referring our material to *R. m. aztecus* as did Jones *et al.* (1988b) for specimens from the northern Texas Panhandle. In size, particularly in the ratio of length of tail to length of head and body, mice from the Muleshoe Sandhills resemble *aztecus*. Average (and extreme) measurements of 30 adults (14 males, 16 females) from the study area are: total length, 141.6 (134-155); length of tail, 67.8 (61-74); length of hind foot, 16.9 (16-18); length of ear, 14.3 (13-15); ratio of tail to head and body, 92.1 (78.2-110.8). Weights of males averaged 10.4 (8.0-12.0), whereas those of 11 nonpregnant females averaged 10.6 (9.5-12.0). Cranial measurements of two species of *Reithrodontomys* from the Muleshoe Sandhills are compared with samples from the Trans-Canadian Panhandle of Texas in Table 3.

Specimens examined (67).—BAILEY CO.: 6 mi. S, 1-2 mi. E Muleshoe, 8; 8.5 mi. S, 16.5 mi. W Muleshoe, 5. LAMB CO.: 4 mi. S, 2.5 mi. E Earth, 9; 5 mi. S, 2.5 mi. E

TABLE 3.—Cranial measurements of adults of two species of *Reithrodontomys* from the Muleshoe Sandhills, and comparative measurements of specimens from the Trans-Canadian Panhandle of Texas (after Jones et al., 1988b). Sample sizes in parentheses; superscript numbers indicate fewer specimens than sample size.

Statistics	Greatest length of skull	Zygomatic breadth	Breadth of braincase	Postorbital constriction	Depth of cranium	Length of rostrum	Breadth of rostrum	Length of max. toothrow
<i>Reithrodontomys montanus griseus</i> , Bailey County, Texas								
TTU 53055, ♀	20.25	10.46	9.13	2.82	7.70	6.95	3.14	3.28
TTU 53357, ♀	19.27	10.41	9.59	3.03	7.49	6.48	3.63	3.37
TTU 55988, ♂	19.76	10.32	9.75	3.03	7.61	6.59	3.23	3.13
Trans-Canadian Panhandle, Texas (15)								
Ave. (7 ♂, 8 ♀)	19.74 ¹⁴	10.41	9.49	3.01	7.48	6.77 ¹⁴	3.58 ¹⁴	3.30
Min.	19.14	9.84	9.19	2.88	7.23	6.41	3.35	3.16
Max.	20.25	10.85	9.77	3.15	7.87	6.99	3.78	3.49
<i>Reithrodontomys megalotis aztecus</i> , Bailey, Lamb, and Hale counties, Texas (25)								
Ave. (12 ♂, 13 ♀)	21.33	10.79	10.24	3.22	7.98	7.59	3.42	3.35
Min.	20.52	10.41	9.90	3.02	7.59	7.05	3.06	3.18
Max.	22.15	11.37	10.71	3.49	8.50	8.07	3.76	3.59
Sherman County, Texas (19)								
Ave. (7 ♂, 12 ♀)	20.62	10.65	10.08	3.17	7.82	7.15	3.50	3.30
Min.	19.83	10.30	9.62	3.03	7.60	6.80	3.22	3.03
Max.	21.23	11.30	10.44	3.44	8.09	7.69	3.88	3.53

Earth, 2; 6 mi. S Springlake, 2; 6.5 mi. N, 0.5 mi. E Fieldton, 1; 5.5-7 mi. S Olton, 7; 3.2 mi. N Fieldton, 4; 10.6 mi. N Spade, 3. HALE CO.: 0.5 mi. N, 11.5-12.5 mi. W Hale Center, 3; 4 mi. N, 5.5 mi. W Cotton Center, 23.

***Reithrodontomys montanus griseus* Bailey, 1905**
Plains Harvest Mouse

This species, which ordinarily avoids sandy substrates, has been taken only in the southwestern part of the study area, southwest of Muleshoe in Bailey County, where it is uncommon on sandy loam soils. Possibly it occurs only in this part of the sandhills, although this species is widespread on the Llano Estacado.

A pregnant female (five fetuses, 11 in crown-rump length) was trapped on 4 October, and a nonpregnant individual was

obtained on 5 November. A March-taken male had testes that measured 5 in length.

Hooper (1952:39) noted that specimens of this species from northwestern Texas, including some from Bailey county, showed evidence of intergradation between *R. m. griseus* and *R. m. montanus* to the west and southwest. He assigned them, however, to *griseus*. Our three specimens had the following external measurements (male followed by two females): total length, 121, 120, 141; length of tail, 57, 51, 64; length of hind foot, 16, 16, 15; length of ear, 14, 13, 13; weight, 8.5, 6.9, 11.0 (pregnant). For cranial measurements, see Table 3.

Specimens examined (3).—BAILEY CO.: 3.2 mi. S, 7.5 mi. W Muleshoe, 1; 5.5 mi. S, 10 mi. W Muleshoe, 1; 8 mi. S, 11 mi. W Muleshoe, 1.

Peromyscus maniculatus luteus Osgood, 1905

Deer Mouse

The deer mouse is a ubiquitous and common small mammal of the sandhill region, being exceeded in numbers on the basis of our trapping results only by *Dipodomys ordii* and *Onychomys leucogaster*. We took specimens in all habitats except in Havard shin oak. These mice appeared to be most common in brushy and grassy areas of sand sage. We were somewhat surprised that the related *Peromyscus leucopus* did not occur in Havard shin oak and other brushy habitats, but we took none of these mice.

The deer mouse probably breeds throughout the year in western Texas. In this study, we examined gravid females taken in January, February, July, October, and November. Number of fetuses ranged from three to six (average, 4.4) in eight pregnancies.

A female and 10 young were found in a baseball-sized nest of shredded paper and feathers under a piece of plywood in a sandy dump area in Bailey County on 22 April. Six of the young had their eyes open, were conspicuously larger (total length, 90–94; weight, 4.8–5.6) than the other four (total length, 73–76; weight, 3.8–4.3), and were attached to the female's mammae. We suppose this was a communal nest, that the two groups of young represent separate litters, and that a second female escaped us without being seen.

Judd (1970) referred *P. maniculatus* from the Llano Estacado to the subspecies *P. m. luteus*, with type locality at Kennedy, Cherry Co., Nebraska. We tentatively follow Judd, but doubt that our specimens ultimately will prove assignable to *luteus*. They average larger and darker in color than typical specimens of that

TABLE 4.—Cranial measurements of adult *Peromyscus maniculatus* from the Muleshoe Sandhills compared with a sample of adults from the Trans-Canadian Panhandle of Texas (after Jones et al., 1988 b). Sample sizes in parentheses; superscript numbers indicate fewer specimens than sample size.

Statistics	Greatest length of skull	Zygomatic breadth	Breadth of braincase	Postorbital constriction	Depth of cranium	Length of rostrum	Breadth of rostrum	Length of max. toothrow
Bailey, Lamb, and Hale counties, Texas (20)								
Ave. (11♂, 9♀)	24.26	12.71	11.16	3.79	8.52	9.01	4.47	3.71
Min.	23.42	11.84	10.68	3.47	8.00	8.51	4.05	3.44
Max.	25.22	13.26	11.57	4.07	9.01	9.60	4.93	4.13
Sherman County, Texas (20)								
Ave. (10♂, 10♀)	24.78 ¹⁹	12.86	11.03	3.90	8.71	9.42 ¹⁹	4.54	3.83
Min.	23.90	12.19	10.52	3.71	8.25	9.05	4.22	3.42
Max.	25.97	13.91	11.41	4.29	9.31	10.10	4.92	4.28

subspecies, and most closely resemble *P. m. pallescens* (type locality, San Antonio, Bexar Co., Texas) among races known to occur in Texas and adjacent New Mexico. Specimens from the Muleshoe Sandhills and elsewhere on the Llano Estacado obviously are in need of critical systematic review. Cranial measurements of a series of adults from the sandhills and a series from the Trans-Canadian Panhandle of Texas are presented in Table 4.

Specimens examined (76).—BAILEY CO.: 8.5 mi. S, 16.5 mi. W Muleshoe, 2; 2 mi. S, 10 mi. W Muleshoe, 3; 3.2 mi. S, 1.5 mi. W Muleshoe, 11; 6 mi. S, 2 mi. E Muleshoe, 2. LAMB CO.: 7.5-10.5 mi. N Sudan, 3; 3.5 mi. S Earth, 1; 4 mi. S, 2.5 mi. E Earth, 3; 4.6 mi. S, 2.6 mi. E Earth, 2; 5-5.5 mi. S, 2.5 mi. E Earth, 13; 6-8 mi. S Springlake, 12; 14.7 mi. N Littlefield, 1; 6.5 mi. N, 0.5 mi. E Fieldton, 1; 5.5-7.2 mi. S Olton, 7; 3.5-4 mi. N Fieldton, 4. HALE CO.: 0.5 mi. N, 12.5 mi. W Hale Center, 6; 4-4.5 mi. N, 5.5 mi. W Cotton Center, 5.

***Onychomys leucogaster arcticeps* Rhoads, 1898**
Northern Grasshopper Mouse

This obligate dust-bather is widely distributed and abundant in the Muleshoe Sandhills. We found it second in numbers only to *Dipodomys ordii*, a species with which it almost invariably was associated. We trapped grasshopper mice in all vegetative

habitats sampled, and found them to be the most frequently collected small mammal in grassy-weedy habitats with adjacent sandy areas.

Judging from our data, *O. leucogaster* breeds from late winter to early autumn in the sandhill region. Pregnant females were collected in the months of March through July and in September. A postlactating individual with placental scars was captured on 4 October. Females obtained in October, November, January, and February were nonpregnant. Fourteen gravid animals carried an average of 4.4 (range, three to six) fetuses.

Males taken in October and November had abdominal testes. Length of those of adult males taken in other months were as follows: 9-16 in January, 6-22 in February, 9-22 in March, 20 in April, 15-23 in May, 13-20 in June, 6-20 in July, 20 in August, and 25 in September. Juvenile mice were collected in May, June, July, October, and November.

Specimens examined (122).—BAILEY CO.: Muleshoe, 2; 0.5 mi. S, 18.2 mi. W Muleshoe, 3; 2 mi. S, 10 mi. W Muleshoe, 2; 2-3.2 mi. S, 7.5 mi. W Muleshoe, 5; 3.2 mi. S, 1.3-3.1 mi. W Muleshoe, 10; 4 mi. S, 1 mi. W Muleshoe, 2; 4.7 mi. S, 18.2 mi. W Muleshoe, 1; 5 mi. S, 18 mi. W Muleshoe, 1; 6 mi. S, 1-3 mi. E Muleshoe, 7; 7 mi. S, 3.5 mi. W Muleshoe, 1; 8 mi. S, 11 mi. W Muleshoe, 1; 9.5 mi. S, 13 mi. W Muleshoe, 2; 9.5 mi. S, 8.5 mi. W Muleshoe, 1. LAMB CO.: 6-7.5 mi. N Sudan, 7; 4-5.5 mi. S, 2.5 mi. E Earth, 17; 6.5-8.5 mi. S Springlake, 15; 14.7 mi. N Littlefield, 1; 6 mi. SW Olton, 2; 5.5-8.5 mi. S Olton, 15; 3.2-4 mi. N Fieldton, 16; 10.6 mi. N Spade, 1. HALE CO.: 0.5 mi. N, 12.5 mi. W Hale Center, 3; 4-4.5 mi. N, 5.5 mi. W Cotton Center, 7.

Sigmodon hispidus texianus (Audubon and Bachman, 1853)

Hispid Cotton Rat

Cotton rats are distributed generally throughout the Muleshoe Sandhills, but are not one of the common small mammals of the region. Many of our specimens were trapped along fencerows, usually where weeds, midgrasses, shrubs, and yucca prevailed.

Six young were born to a female in a live trap on 4 July. A pregnant female carrying seven fetuses (5 in crown-rump length) was taken on 5 June. Three more collected on 8 June had five, six, and 11 fetuses that measured 38, 34, and 5, respectively. Adult males captured in February, May, June, and July (two) had testes that measured, respectively, 15, 18, 22, 20, and 22 in length.

Specimens examined (24).—BAILEY CO.: Muleshoe, 1; 9.5 mi. S, 8.5 mi. W Muleshoe, 1. LAMB CO.: 10 mi. N, 0.2 mi. W Sudan, 8; 4 mi. S, 2.5 mi. E Earth, 4; 7.2 mi. S Earth, 2; 5.5 mi. S Olton, 1; 7 mi. S Olton, 4; 8.5 mi. S, 1 mi. E Olton, 1; 10.6 mi. N Spade, 1. HALE CO.: 4 mi. N, 5.5 mi. W Cotton Center, 1.

Neotoma micropus canescens J. A. Allen, 1891

Southern Plains Woodrat

This woodrat apparently is uncommon in the sandhill area. Specimens are on record only from Lamb County. Few of the characteristic nests of this species were observed, and no *Neotoma* remains were recovered from owl pellets analyzed from Bailey and Lamb counties. Of the three rats we collected, two juveniles were taken in Sherman traps on 5 June in dense shrub with yucca, whereas an adult female was shot on 22 April after being chased from a nest in a dry drainage bed into which some refuse had been thrown. Several other nests were observed in the same area amid yucca, sparse grasses, and some mesquite; one was built atop and within a large tractor tire, another at the base of a juniper. The female carried three large (crown-rump length, 44) fetuses.

Specimens examined (6).—LAMB CO.: 4.6 mi. S, 2.6 mi. E Earth, 2; 5.5 mi. S Earth, 1; 14.8 mi. N Littlefield, 1; 3 mi. N Fieldton, 2.

Rattus norvegicus (Berkenhout, 1769)

Norway Rat

Our only record from the Muleshoe Sandhills of this introduced rodent comes from remains of an individual recovered from an owl pellet found 1 mi. N and 5 mi. E Fieldton, Lamb county (Pesaturo *et al.*, 1989). Probably this rat will be found around feedlots and at other places of human activity elsewhere in the region.

Mus musculus Linnaeus, 1758

House Mouse

We took specimens of this Old World native, primarily a commensal of man, in both Hale and Lamb counties, and found remains in owl pellets from Bailey County. Feral populations were found in thick, grassy-weedy situations, and also along the grassy borders of rangeland. These mice seem to avoid open, sandy areas. A female taken on 14 July carried nine fetuses that were 15 in crown-rump length.

Specimens examined (16).—LAMB CO.: 10 mi. N, 0.2 mi. W Sudan, 2; 6 mi. S Springlake, 1; 14.7 mi. N Littlefield, 1; 5.5 mi. S Olton, 2; 4 mi. N Fieldton, 1. HALE CO.: 0.5 mi. N, 11.5-12.5 mi. W Hale Center, 4; 4 mi. N, 5.5 mi. W Cotton Center, 5.

Erethizon dorsatum couesi Mearns, 1897

Porcupine

Porcupines evidently range sparingly throughout the sandhill region. Although we obtained no specimens, we recorded individuals killed along roadways as follows: 1.5 mi. S Muleshoe, Bailey County, on 4 November 1988; 2.8 mi. SE Muleshoe, Bailey County, on 28 February 1988; 7.5 mi. N Sudan, Lamb County, on 14 October 1988. We follow Hall (1981) in use of the subspecific name *couesi*; geographic variation remains to be studied in this species.

Canis latrans latrans Say, 1823

Coyote

This canid is common throughout the study area. We frequently heard coyotes calling in the evening and observed them crossing roadways at night, in one instance an adult followed by three or four young. Ranchers in the sandhills routinely shoot coyotes and hang the carcasses on fences.

Specimens examined (5).—LAMB CO.: 4-6 mi. N Fieldton, 5.

Urocyon cinereoargenteus scottii Mearns, 1891

Gray Fox

One of us (Pesaturo) found remains of a gray fox on Farm-to-Market Road 746 at a place 6.5 mi. S and 7.5 mi. W Muleshoe, Bailey County, on 27 February 1988. We know of no other records from the Muleshoe Sandhills.

Mustela frenata neomexicana (Barber and Cockerell, 1898)

Long-tailed Weasel

This weasel seems to be relatively common elsewhere on the central Llano Estacado, but we neither took nor observed it in the sandhill region. We have examined, however, a single specimen from the sandhills in Lamb County that was obtained in 1968.

Specimens examined (1).—LAMB CO.: 3.3 mi. N Fieldton, 1.

Taxidea taxus berlandieri Baird, 1858

Badger

Although we took no specimens, we observed badgers crossing roadways or killed on them in all three sandhill counties as follows:

9.5 mi. S, 13 mi. W Muleshoe, and 6.5 mi. S, 6.5 mi. W Muleshoe, Bailey County; 7.5 mi. N Sudan, Lamb County; and 4.5 mi. N, 5.5 mi. W Cotton Center, Hale County. This species evidently is widespread, if uncommon, in the tricounty sandhill area.

Mephitis mephitis varians Gray, 1837

Striped Skunk

This skunk rivals the coyote as the most visible carnivore in the Muleshoe Sandhills. Individuals commonly were seen along roadways at night. We have observations from all three counties in the study area.

A road-killed female found on 30 April carried six fetuses that measured 31 in crown-rump length. A male trapped at the entrance to its burrow on 11 February had testes that measured 20 × 14.

Specimens examined (4).—BAILEY CO.: 1 mi. N, 7.5 mi. W Muleshoe, 1; 6 mi. S Muleshoe, 1. LAMB CO.: 2 mi. S Earth, 1; 5.5 mi. S, 2.5 mi. E Earth, 1.

Felis rufus texensis (J. A. Allen, 1895)

Bobcat

The bobcat is generally distributed on the Llano Estacado, especially in broken country. We observed an individual 1 mi. N and 5 mi. W Muleshoe in June 1988. Schmidly and Read (1986) referred bobcats from throughout Texas to the subspecies *texensis*.

Odocoileus hemionus crooki (Mearns, 1897)

Mule Deer

Mule deer are uncommon in the sandhill area, being mostly limited to the vicinity of the few draws and their adjacent vegetative cover. One buck was seen in Lamb County in an area of tall grass near dunes covered with low shrubs. Several landowners reported the occurrence of this deer to us as well, one near the New Mexican border noting that a herd of approximately 20 ranged on his ranch.

Species of Possible Occurrence

The following list contains species that are known to occur in Texas adjacent to the Muleshoe Sandhills, or in several cases, have been reported from the New Mexican part of the region, and well may be found in the tricounty study area. Not included are species like the gray wolf, *Canis lupus*, or the bison, *Bison*

bison, which once occupied this country but have been extirpated by man.

In addition, specific mention of bats is not included because there are few places in the tricounty sandhills where bats could find suitable refuge other than an occasional abandoned building or isolated stand of trees. However, some species no doubt migrate through the region in season and it always is possible that migrants could be collected there.

Notiosorex crawfordi (desert shrew).—This shrew occurs throughout the Llano Estacado and thus no doubt occupies the Muleshoe Sandhills. Use of pitfall traps and examination of owl pellets may be the best means to establish its presence.

Bassariscus astutus (ringtail).—We have no records of this species from the Texas part of the Muleshoe Sandhills, and we doubt it occurs there with the possible exception of an occasional stray animal. Aday and Gennaro (1973) reported a specimen taken 6.4 mi. N and 6 mi. W Portales, Roosevelt Co., New Mexico, 23 miles west of the Bailey County border.

Procyon lotor (raccoon).—Several ranchers reported to us that they had seen "coons" in the tricounty study area, but that they were "rare." We observed no evidence of the presence of raccoons, but they may occur infrequently in the Muleshoe Sandhills.

Vulpes velox (swift fox).—This small canid is widespread and relatively common on parts of the Llano Estacado. Aday and Gennaro (1973) reported a specimen from the sandhills 4 mi. N and 1 mi. E Portales, Roosevelt Co., New Mexico, some 17 miles west of the Texas (Bailey County) border.

Vulpes vulpes (red fox).—A rancher in eastern Lamb county reported to us that he once had seen a red fox. We would expect this species to be sparingly distributed at least along the periphery of the sandhills.

Spilogale putorius (spotted skunk).—This small mustelid has been reported from nearby Hockley and Lubbock counties, Texas, and possibly occurs in the study area.

DISCUSSION

The diversity of mammals found in the Muleshoe Sandhills is typical of such a physiographic feature on the Great Plains. Of 30 species of mammals recorded, 18 were rodents. Bats, which were not recorded by us, no doubt occur sparingly in the sandhill region, at least as migrants.

Based on 19 months of work in the Muleshoe Sandhills, we found *Dipodomys ordii* to be by far the most abundant mammal, with *Onychomys leucogaster* second in abundance. *Peromyscus maniculatus* and *Reithrodontomys megalotis* also were common. We observed or obtained six species of carnivores, although five other species possibly occur in the sandhill region. Only two of the recorded species, *Mephitis mephitis* and *Canis latrans*, can be considered common.

Biological data such as reproductive condition, morphometrics, and natural history observations were noted for most species. In several cases, *Geomys*, *Chaetodipus*, *Reithrodontomys*, and *Onychomys*, for example, reproductive data (size of testes in males, presence and size of fetuses in females) was correlated with changing seasons.

Placement of taxa at the subspecific level was based on geographic variation as established in the literature and by our analysis of specimens housed in The Museum, Texas Tech University. Several species currently are in need of systematic review concerning geographic variation and affinities of populations on the southern Great Plains.

Results obtained from trapping (both live traps and snap traps) were analyzed to determine the relative abundance of selected rodent species found in each of the six major plant communities in the Muleshoe Sandhills. Two species, *D. ordii* and *O. leucogaster*, were the most frequently taken small mammals, trapped in five out of the six communities. The hackberry-shrub series, characterized by few open sandy areas and dense vegetation, was the exception. In this community, *R. megalotis* was the most common (22.7 percent of specimens taken) small mammal, probably due to the propensity of this mouse for thick, brushy habitats. This species was absent or uncommon in the mixed grass-yucca and the sand sage-midgrass communities. Conversely, *Reithrodontomys montanus* was captured only in the mixed grass-yucca and tallgrass-ragweed-Russian thistle communities, indicating a preference for sandy-grassy areas.

Although taken in all but one habitat, *Perognathus flavescens* was not especially common except in the sand sage-midgrass community (13.1 percent of all captures), affirming its attraction to sand sage-dominated sandy areas. *Chaetodipus hispidus* was not found to be a particularly common inhabitant of the Muleshoe Sandhills. This species was trapped second in frequency (19.1 percent) to *R. megalotis* in the hackberry-shrub community, and,

in fact, was found in proportions similar to *R. megalotis* in most communities. *Peromyscus maniculatus* was collected in moderate numbers in most of the communities. In summary, from our sample size of approximately 500 small rodents, the occurrence and relative abundance of species in plant communities generally coincided with habitat preferences reported in the literature.

The Muleshoe Sandhills have remained mostly unaltered by human activity as opposed to the majority of the Llano Estacado, which is a rich agricultural region. Ranching, still commonly practiced in the sandhills, does not disturb the original habitat as drastically as does farming. This suggests that the unique physical, floral, and faunal characteristics of the Muleshoe Sandhills are in no immediate danger of major alteration.

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LITERATURE CITED

- ADAY, B. J., JR., AND A. L. GENNARO. 1973. Mammals (excluding bats) of the New Mexican Llano Estacado and its adjacent river valleys. *Stud. Nat. Sci., Eastern New Mexico Univ.*, 1(5): 1-33, 44 maps.
- ALLRED, B. W., AND H. P. MITCHELL. 1955. Major plant types of Arkansas, Louisiana, Oklahoma and Texas and their relation to climate and soils. *Texas J. Sci.*, 7:7-19.
- BAILEY, V. 1905. Biological survey of Texas. *N. Amer. Fauna*, 25:1-222.
- BARKLEY, T. M. (ed.). 1986. *Flora of the Great Plains*. Univ. Press Kansas, Lawrence, vii + 1392 pp.
- BAUMGARDNER, G. D., AND D. J. SCHMIDLY. 1981. Systematics of the southern races of two species of kangaroo rats (*Dipodomys compactus* and *D. ordii*). *Occas. Papers Mus., Texas Tech Univ.*, 73:1-27.
- BLAIR, W. F. 1950. The biotic provinces of Texas. *Texas J. Sci.*, 2:93-117.
- . 1954. Mammals of the Mesquite Plains Biotic District of Texas. *Texas J. Sci.*, 4:230-250.
- CHOATE, L. L., J. K. JONES, JR., R. W. MANNING, AND C. JONES. 1990. Westward ho: continued dispersal of the pygmy mouse, *Baiomys taylori*, on the Llano Estacado and in adjacent areas of Texas. *Occas. Papers Mus., Texas Tech Univ.*, 134:1-8.

- DAVIS, W. B. 1974. The mammals of Texas. Bull. Texas Parks Wildlife Dept., 41:1-294.
- DESHA, P. G. 1967. Variation in a population of kangaroo rats, *Dipodomys ordii medius* (Rodentia: Heteromyidae) from the High Plains of Texas. Southwestern Nat., 12:275-289.
- GOULD, F. W. 1978. Common Texas grasses. Texas A&M Univ. Press, College Station, x + 267 pp.
- HALL, E. R. 1981. The mammals of North America. John Wiley & Sons, New York, 2nd ed., 1:xv + 1-600 + 90 and 2:vi + 601-1181 + 90.
- HOLLANDER, R. R., J. K. JONES, JR., R. W. MANNING, AND C. JONES. 1987. Noteworthy records of mammals from the Texas Panhandle. Texas J. Sci., 39: 97-102.
- HOOVER, E. T. 1952. A systematic review of the harvest mice (genus *Reithrodontomys*) of Latin America. Misc. Publ. Mus. Zool., Univ. Michigan, 77:1-255, 9 pls.
- JONES, J. K., JR., AND B. MURSALOĞLU. 1961. Geographic variation in the harvest mouse, *Reithrodontomys megalotis*, on the central Great Plains and in adjacent regions. Univ. Kansas Publ., Mus. Nat. Hist., 14:9-27.
- JONES, J. K., JR., C. JONES, AND D. J. SCHMIDLY. 1988a. Annotated checklist of Recent land mammals of Texas. Occas. Papers, Mus., Texas Tech Univ., 119:1-26.
- JONES, J. K., JR., R. W. MANNING, R. R. HOLLANDER, AND C. JONES. 1987. Annotated checklist of Recent mammals of northwestern Texas. Occas. Papers, Mus., Texas Tech Univ., 111:1-14.
- JONES, J. K., JR., R. W. MANNING, C. JONES, AND R. R. HOLLANDER. 1988b. Mammals of the northern Texas Panhandle. Occas. Papers Mus., Texas Tech Univ., 126:1-54.
- JONES, J. K., JR., D. C. CARTER, H. H. GENOWAYS, R. S. HOFFMANN, D. W. RICE, AND C. JONES. 1986. Revised checklist of North American mammals north of Mexico, 1986. Occas. Papers Mus., Texas Tech Univ., 107:1-22.
- JUDD, F. D. 1970. Geographic variation in the deer mouse, *Peromyscus maniculatus*, on the Llano Estacado. Southwestern Nat., 14:261-282.
- MANNING, R. W., C. JONES, J. K. JONES, JR., AND R. R. HOLLANDER. 1988. Subspecific status of the pallid bat, *Antrozous pallidus*, in the Texas Panhandle and adjacent areas. Occas. Papers Mus., Texas Tech Univ., 118:1-5.
- MCMAHAN, C. A., R. G. FRYE, AND K. L. BROWN. 1984. The vegetation types of Texas including cropland. Texas Parks and Wildlife Dept., Austin, ii + 40 pp. + map.
- OWEN, R. D., AND M. J. HAMILTON. 1986. Second record of *Cryptotis parva* (Soricidae: Insectivora) in New Mexico, with review of its status on the Llano Estacado. Southwestern Nat., 31:403-405.
- PESATURO, R. J., R. W. MANNING, AND J. K. JONES, JR. 1989. Small mammals captured by barn owls in Lamb County, Texas. Texas J. Sci., 41: 433-434.
- REED, K. M., AND J. R. CHOATE. 1986. Geographic variation in the plains pocket mouse (*Perognathus flavescens*) on the Great Plains. Texas J. Sci., 38: 227-240.
- ROSS, W. J., AND O. F. BAILEY. 1967. Soil survey of Roosevelt County, New Mexico. U. S. Dept. Agric., Soil Conserv. Serv., 1-72 pp. + maps.
- ROSSON, T. C. 1971. Vascular flora of Bailey County, Texas. Unpublished M.S. thesis, Texas Tech Univ., Lubbock, iv + 145 pp.
- SCHMIDLY, D. J. 1971. Population variation in *Dipodomys ordii* from western Texas. J. Mamm., 52:108-120.

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